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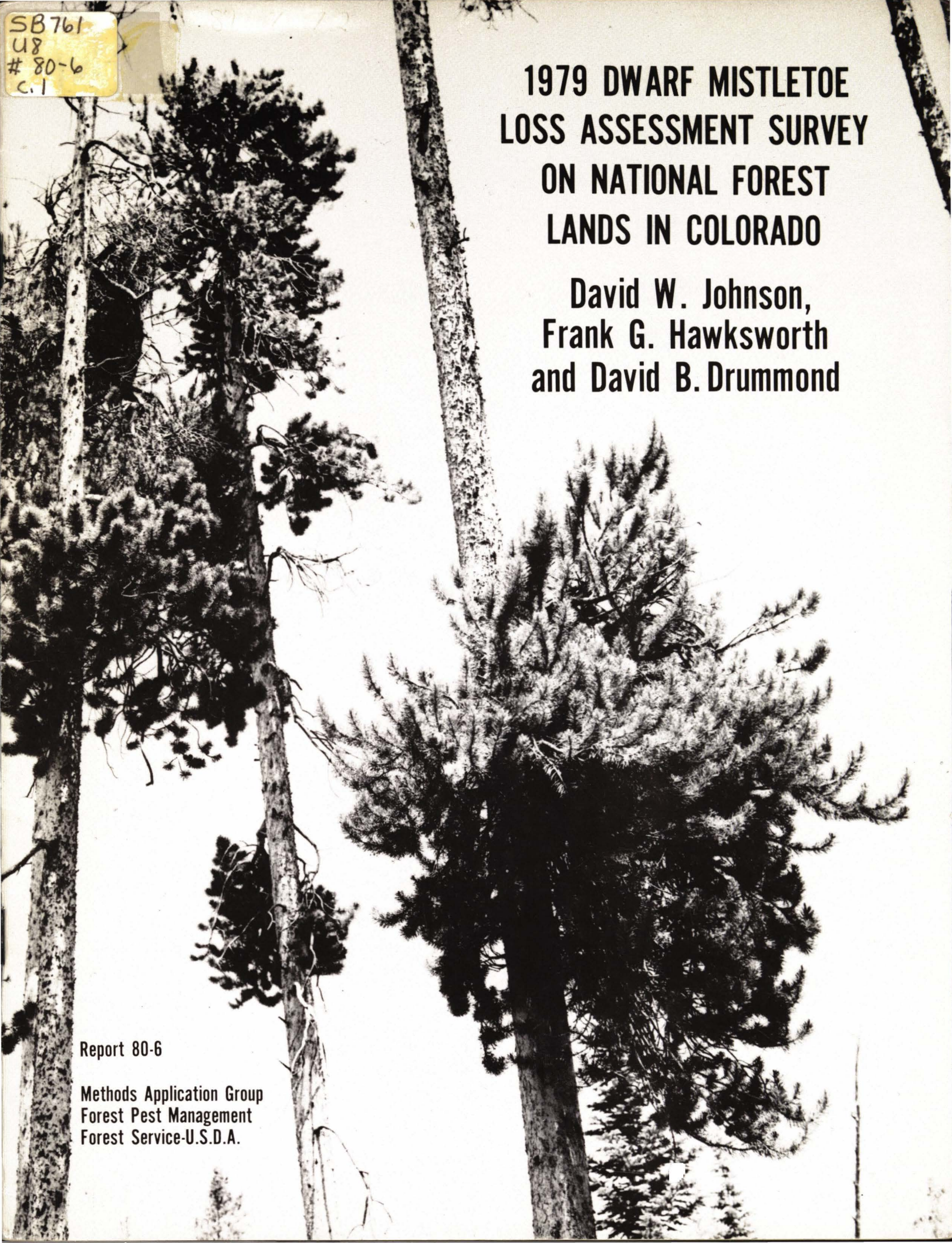

Report 80-6

Methods Application Group
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1979 DWARF MISTLETOE LOSS ASSESSMENT SURVEY ON NATIONAL FOREST LANDS IN COLORADO

David W. Johnson, Frank G. Hawksworth, and David B. Drummond[1]

ABSTRACT

During 1979, a road/plot survey to estimate volume loss caused by lodgepole pine dwarf mistletoe was conducted on six National Forests in Colorado. The proportion of host type infested by dwarf mistletoe ranged from 0 percent on the Rio Grande National Forest to 52.1 percent on the Routt National Forest. All Forests combined averaged 46.6 percent. Estimates of annual merchantable cubic-foot volume loss for infested Forests ranged from a low of 31.2 M on the White River National Forest to 2398.6 M on the Arapaho and Roosevelt National Forests. Combined annual loss for all Forests is estimated to be greater than 4.6 million cubic feet. This loss represents 1.3 times the annual harvest of lodgepole pine sawtimber for National Forests in Colorado or between 20 and 25 percent of the annual growth.

INTRODUCTION

During 1979, a survey was conducted on National Forests in Colorado to estimate annual merchantable cubic-foot volume loss caused by lodgepole pine dwarf mistletoe, Arceuthobium americanum Nutt. ex Engelm., in lodgepole pine, Pinus contorta Dougl. ex Loud. Previous reports presented assessments of loss due to this pest in lodgepole pine for Wyoming National Forests (Johnson et al. 1978, 1979).

METHODS

National Forests included in this survey are listed below and shown in Fig. 1. Several were combined for the assessment.

1. Arapaho and Roosevelt
2. Grand Mesa, Gunnison and Uncompahgre
3. Pike and San Isabel
4. Rio Grande
5. Routt
6. White River

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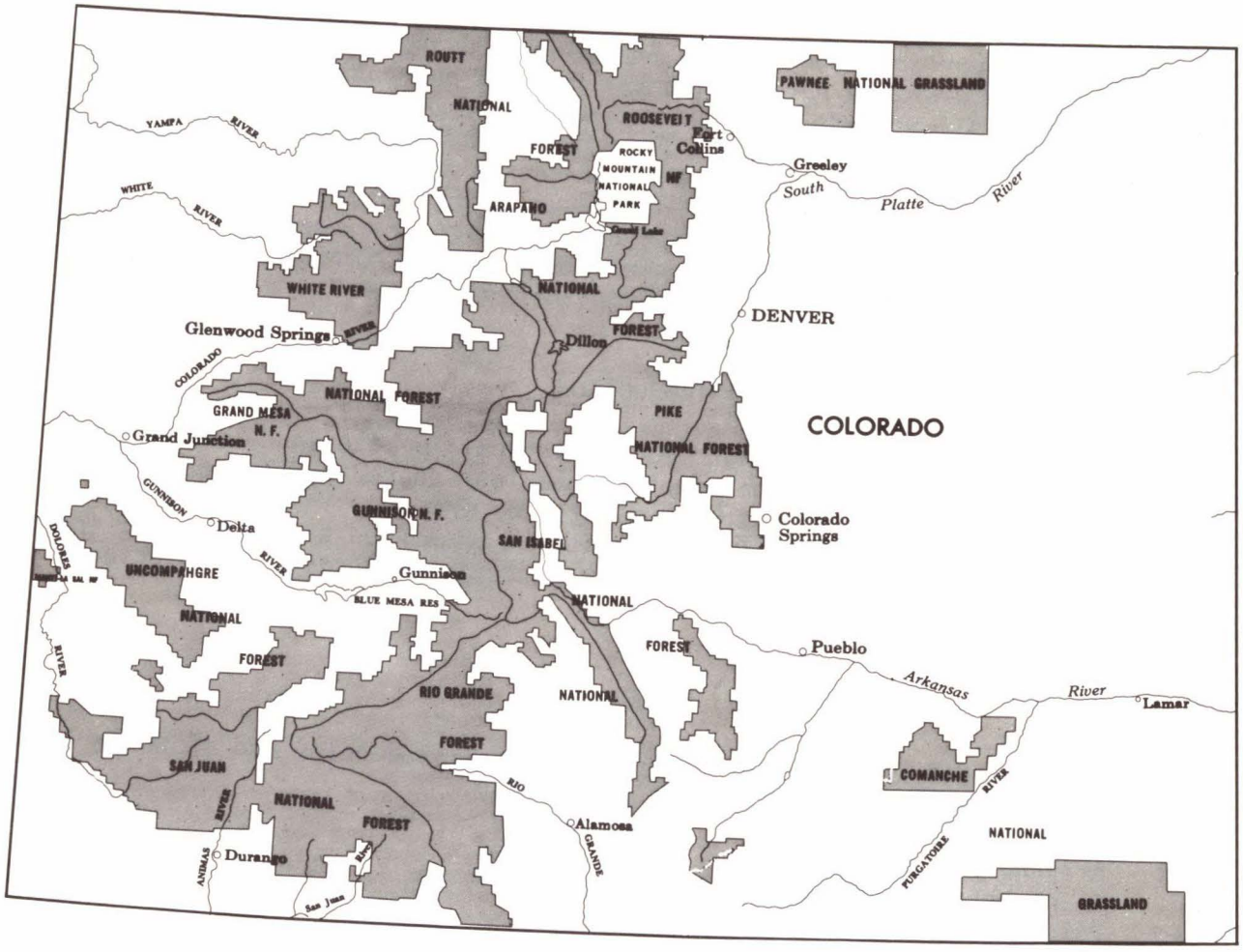

Figure 1. National Forests included in this survey

The survey was conducted in two stages, the first consisting of a roadside reconnaissance, the second, a series of variable-radius plots located at predetermined intervals along roads through lodgepole pine type.

Survey crews drove the majority of the passable roads through the lodgepole pine type at speeds less than 10 miles per hour. Trees were observed to a distance of one-chain into the Forest parallel to the right side of the road. Mileage was recorded to the nearest 0.1 mile whenever a change in timber type, size class, or dwarf mistletoe infection intensity was noted. This represented a sampling intensity of approximately 0.5 percent of the lodgepole pine type. The criteria for the road reconnaissance were:

Lodgepole pine type - more than 50 percent of the trees in the stand were lodgepole pine.

Size class - based on the estimated diameter of trees in the stand.

Seedling/sapling = trees less than 5 inches diameter at breast height (dbh)

Pole = trees 5 to 9 inches dbh

Mature = trees greater than 9 inches dbh

Infection intensity -

0 = no infection
1 = less than one-third of the trees infected
2 = one-third to two-thirds of the trees infected
3 = greater than two-thirds of the trees infected

Crews established variable-radius plots (basal area factor [BAF] 10) two chains into the stand every three miles on the right side of and perpendicular to the road. If that location was non-type, the plot was placed on the left side of the road. If both locations were non-type, the plot was discarded without replacement. Diameter at breast height and dwarf mistletoe rating (DMR) (Hawksworth 1977) were recorded for all lodgepole pine greater than 4.9 inches dbh. The age of one representative tree on or near each plot was estimated from an increment core and used in calculating site index and producing yield tables. Data on reproduction (trees $\leq$ 4.9 dbh) were recorded using a 0.01-acre circular plot.

Roadside reconnaissance data were used to estimate the proportion of lodgepole pine type infested with dwarf mistletoe. This was done by determining the ratio of the number of miles traveled adjacent to infested stands to the total miles traveled adjacent to lodgepole pine type.

The Rocky Mountain Yield Simulation Model (RMYLD) (Edminster (1978) was used to estimate merchantable cubic-foot volume loss in lodgepole pine from dwarf mistletoe. The average DMR for each plot was used to make this estimate. Since mistletoe infestations in the seedling-sapling size class have no effect on present yield, only data from pole-and sawtimber-size plots were used. Loss estimates were derived by making two consecutive runs of the

model, the first using the average DMR for each plot and the second with the plot DMR converted to zero to represent non-infested stands. The former, estimating yield with dwarf mistletoe present, was subtracted from the latter which simulated growth for all stands over the next decade as if no dwarf mistletoe were present. Resulting values were divided by 10 to obtain an estimate of annual loss.

Estimates of the number of acres of commercial lodgepole pine type for each National Forest were obtained from the most recent timber management plans. Only acres of pole- and sawtimber-size classes were used as no current merchantable volume loss in seedling or sapling size stands will occur. Future loss of volume due to dwarf mistletoe in these stands was not considered in this assessment.

RESULTS

This survey indicated that 46.9 percent of the 762.6 miles traversed within lodgepole pine type were adjacent to mistletoe-infested stands (table 1). However, only 32.2 percent of the 264 plots established in conjunction with the road survey contained infected trees. Disease incidence was greatest on the Routt and the Grand Mesa, Gunnison, and Uncompahgre National Forests where 52.3 percent of miles driven were adjacent to infested stands. No infested stands were encountered on the Rio Grande National Forest; however, the area occupied by lodgepole pine type on this Forest is small, and the parasite may have been missed because of the low number of miles traveled and the small number of plots established in host type.

Table 1. Miles traversed within lodgepole pine type surveyed in 1979 and incidence of Arceuthobium americanum listed by National Forest in Colorado.

National Forest	Miles surveyed within type	Miles adjacent to infested stands	% Adjacent to infested stands
Arapaho and Roosevelt	345.8	166.7	48.2
Grand Mesa, Gunnison, and Uncompahgre	77.2	40.4	52.3
Pike and San Isabel	112.0	48.5	43.3
Rio Grande	7.2	0.0	0.0
Routt	139.7	73.1	52.3
White River	80.7	28.7	35.5
Totals	762.6	357.4	46.9

A summary of miles driven within lodgepole pine type by Forest, timber size class and dwarf mistletoe infection intensity is presented in table 2[1]. This table shows that 497.2 of 762.6 miles (65.2 percent) traveled were adjacent to pole-size stands. The greatest number of miles traveled adjacent to infested stands also occurred in this class (261.6 miles or 34.3 percent). More pole-size lodgepole pine stands were infested than were non-infested (52.6 percent). There was a higher rate of infestation in pole-size stands than the seedling-sapling class (23.0 percent) and the mature class (44.5 percent). The pole-size stands represent the tree population from which the next crop is expected.

Estimates of annual merchantable cubic-foot volume loss for each Forest are summarized in table 3[2]. The Arapaho and Roosevelt National Forests had the greatest estimated annual loss, 2398.6 M cubic feet. The lowest level of loss, excluding the Rio Grande where mistletoe was not found on lodgepole pine, was the White River. The total annual loss for all Colorado Forests is estimated at over 4.6 MM cubic feet (table 3). This loss represents 1.3 times the volume of lodgepole pine sawtimber harvested annually from Colorado National Forests or between 20 and 25 percent of the mean annual growth for this species.

The data presented for the White River are thought to be conservative since no plots were found with dwarf mistletoe severity categories above 3.0. With a road survey estimate of 35.5 percent of the lodgepole pine type affected by dwarf mistletoe, and the fact that surrounding Forests with affected areas only slightly higher than the White River, but with loss estimates 20 to 40 fold greater, it seems unreasonable that the severity data and loss estimate (table 3) accurately reflect the situation on the White River National Forest.

CONCLUSIONS

The objective of this survey was to obtain a better estimate of the magnitude of dwarf mistletoe-caused losses in lodgepole pine for Colorado, not to provide such information for specific management units within each National Forest. The data indicate that A. americanum is widespread in Colorado, and that almost half of the lodgepole type is infested. Management decisions must be made for each of these stands. However, prior to the development of silvicultural prescriptions, the land manager must have a complete description of each stand, including age, structure, stocking, and site index, together with reasonably accurate information on dwarf mistletoe distribution and intensity. Survey procedures designed to provide specific information for individual management units (Johnson and Hawksworth 1978) and guidelines for control projects (Dooling and Brown 1976) are available.

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1 Data for each Forest are presented in tables 4-9 in the Appendix.

2 Individual Forest data are appended.

Table 3. Estimates of merchantable volume loss due to dwarf mistletoe in lodgepole pine stands on National lands in Colorado.

National Forest	Commercial Host type (M acres)[1]	Infested Acres % [2]	Infested Acres (M) No.[3]	Total Merchantable volume loss[4] (M cu ft/yr)	Merchantable volume loss[5] (cu ft/A/yr)
Arapaho and Roosevelt	458.4	48.2	220.9	2398.6	10.9
Grand Mesa, Gunnison and Uncompahgre	147.6	52.3	77.2	459.1	5.9
Pike and San Isabel	177.0	43.3	76.6	656.4	8.6
Rio Grande	6.3	0.0	0.0	0.0	0.0
Routt	173.1	52.3	90.5	1057.4	11.7
White River	147.0	35.5	52.2	31.2	0.6[6]
Totals	1109.4	46.6	517.4	4602.7	8.9

1 From most recent Timber Management Plans (pole- and sawtimber-size stands only).

2 From road survey (1979).

3 Derived from columns 1 and 2

4 Plot data

5 $\frac{\text{Total Merchantable Vol. Loss}}{\text{Acres Infested}}$

6 The authors do not feel that this value truly represents the loss on the White River National Forest. Apparently the number of plots representing high infection levels was low. One would not expect a value this low when 35 % of the type was infected. As a result the overall estimate for Colorado is considered conservative.

Table 2. Miles of road traveled within dwarf mistletoe infested and non-infested lodgepole pine type for Colorado National Forests by timber size class.

National Forest	Size class[1] SS Infested	SS Non-infested	P Infested	P Non-infested	M Infested	M Non-infested	Total
Arapaho and Roosevelt	12.4	40.0	132.4	111.9	21.9	27.2	345.8
Grand Mesa, Gunnison, and Uncompahgre	2.3	6.5	31.6	17.9	6.5	12.4	77.2
Pike and San Isabel	2.2	6.9	32.7	42.1	13.6	14.5	112.0
Rio Grande	0.0	0.2	0.0	6.1	0.0	0.9	7.2
Routt	5.8	22.4	42.4	26.7	24.9	17.5	139.7
White River	1.1	3.4	22.5	31.2	5.1	17.4	80.7
Totals	23.8	79.4	261.6	235.9	72.0	89.9	762.6

1 Size class: SS = seedling sapling, < 5.0 in. dbh; P = pole, 5.0 to 9.0 in. dbh; M = mature, > 9.0 in. dbh.

Table 3. Estimates of merchantable volume loss due to dwarf mistletoe in lodgepole pine stands on National lands in Colorado.

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Rio Grande	6.3	0.0	0.0	0.0	0.0
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APPENDIX

Table I. Miles of road traveled within lodgpeole pine type on the Arapaho and Roosevelt National Forests by timber size class and dwarf mistletoe infection intensity.

Dwarf mistletoe infection intensity	Size class SS	P	M	Total
0	40.0	111.9	27.2	179.1
1	7.3	46.4	6.6	60.3
2	3.4	40.3	4.7	48.4
3	1.7	45.7	10.6	58.0
Total	52.4	244.3	49.1	345.8

Table II. Miles of road traveled within lodgepole pine type on the Grand Mesa, Gunnison, and Uncompahgre National Forests by timber size class and dwarf mistletoe infection intensity.

Dwarf mistletoe infection intensity	Size class SS	P	M	Total
0	6.5	17.9	12.4	36.8
1	0.9	10.1	2.0	13.0
2	0.7	10.4	2.3	13.4
3	0.7	11.1	2.2	14.0
Total	8.8	49.5	18.9	77.2

1 Infection intensity: 0 = no infection; 1 = < 1/3 of trees infected; 2 = 1/3 to 2/3 of trees infected; 3 = > 2/3 of trees infected.

2 Size class: SS = seedling sapling, < 4.9 in. dbh; P = pole, 5.0 to 8.9 in. dbh; M = mature, > 9.0 in. dbh.

Table III. Miles of road traveled within lodgepole pine type on the Pike and San Isabel National Forest by timber size class and dwarf mistletoe infection intensity.

Dwarf mistletoe infection intensity	Size class SS	P	M	Total
0	6.9	42.1	14.5	63.5
1	0.6	9.8	5.2	15.6
2	0.7	9.4	4.9	15.0
3	0.9	13.5	3.5	17.9
Total	9.1	74.8	28.1	112.0

Table IV. Miles of road traveled within lodgepole pine type on the Rio Grande National Forest by timber size class and dwarf mistletoe infection intensity.

Dwarf mistletoe infection intensity	Size class SS	P	M	Total
0	0.2	6.1	0.9	7.2
1	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
Total	0.2	6.1	0.9	7.2

1 Infection intensity: 0 = no infection; 1 = < 1/3 of trees infected; 2 = 1/3 to 2/3 of trees infected; 3 = > 2/3 of trees infected.

2 Size class: SS = seedling sapling, < 4.9 in. dbh; P = pole, 5.0 to 8.9 in. dbh; M = mature, > 9.0 in. dbh.

Table V. Miles of road traveled within lodgepole pine type on the Routt National Forest by timber size class and dwarf mistletoe infection intensity.

Dwarf mistletoe infection intensity	Size class SS	P	M	Total
0	22.4	26.7	17.5	66.6
1	4.3	15.4	9.4	29.1
2	0.7	12.6	7.9	21.2
3	0.8	14.4	7.6	22.8
Total	28.2	69.1	42.4	139.7

Table VI. Miles of road traveled within lodgepole pine type on the White River national Forest by timber size class and dwarf mistletoe infection intensity.

Dwarf mistletoe infection intensity	Size class SS	P	M	Total
0	3.4	31.2	17.4	52.0
1	0.6	7.3	2.6	10.5
2	0.4	7.6	1.6	9.6
3	0.1	7.6	0.9	8.6
Total	4.5	53.7	22.5	80.7

1 Infection intensity: 0 = no infection; 1 = < 1/3 of trees infected; 2 = 1/3 to 2/3 of trees infected; 3 = > 2/3 of trees infected.

2 Size class: SS = seedling sapling, < 4.9 in. dbh; P = pole, 5.0 to 8.9 in. dbh; M = mature, > 9.0 in. dbh.

Table VII. Acres of dwarf mistletoe infestation represented by survey plots and annual merchantable cubic-foot volume loss estimates for the Arapaho and Roosevelt National Forests lodgepole pine stands by seven dwarf mistletoe severity categories.

Dwarf mistletoe severity category	No. plots	% Representation	M acres	Merchantable volume loss (cu ft/A/yr)	Total merchantable vol. loss/yr (M cu ft)
0	69	59.5	272.7	0.0	0.0
0.1 - 1.0	9	7.8	35.7	0.0	0.0
1.1 - 2.0	7	6.0	27.5	0.1	2.7
2.1 - 3.0	7	6.0	27.5	4.3	118.2
3.1 - 4.0	7	6.0	27.5	9.7	266.7
4.1 - 5.0	8	6.9	31.7	17.7	561.1
5.1 - 6.0	9	7.8	35.8	40.5	1449.9
Totals	116	100	458.4[1,2]	--	2398.6

1 Acres of type from most recent Timber Management Plan (1975-76).

2 Acres for each category shown in column 4 = % shown in column 3 X 458.4 acres.

Table VIII. Acres of dwarf mistletoe infestation represented by survey plots and annual merchantable cubic-foot volume loss estimates for the Grand Mesa, Gunnison, and Uncompahgre National Forests lodgepole pine stands by seven dwarf mistletoe severity categories.

Dwarf mistletoe severity category	No. plots	% Representation	M acres	Merchantable volume loss (cu ft/A/yr)	Total merchantable vol. loss/yr (M cu ft)
0	25	78.2	115.4	0.0	0.0
0.1 - 1.0	0	0.0	0.0	0.0	0.0
1.1 - 2.0	2	6.2	9.1	0.0	0.0
2.1 - 3.0	0	0.0	0.0	0.0	0.0
3.1 - 4.0	1	3.2	4.7	37.0	173.9
4.1 - 5.0	2	6.2	9.2	14.0	128.8
5.1 - 6.0	2	6.2	9.2	17.0	156.4
Totals	32	100	147.6[1,2]	--	459.1

1 Acres of type from most recent Timber Management Plan (1975-76).

2 Acres for each category shown in column 4 = % shown in column 3 X 147.6 acres.

Table IX. Acres of dwarf mistletoe infestation represented by survey plots and annual merchantable cubic-foot volume loss estimates for the Pike and San Isabel National Forests lodgepole pine stands by seven dwarf mistletoe severity categories.

Dwarf mistletoe severity category	No. plots	% Representation	M acres	Merchantable volume loss (cu ft/A/yr)	Total merchantable vol. loss/yr (M cu ft)
0	31	77.5	137.2	0.0	0.0
0.1 - 1.0	1	2.5	4.4	0.0	0.0
1.1 - 2.0	1	2.5	4.4	0.0	0.0
2.1 - 3.0	0	0.0	0.0	0.0	0.0
3.1 - 4.0	3	7.5	13.4	6.3	84.4
4.1 - 5.0	2	5.0	8.8	30.0	264.0
5.1 - 6.0	2	5.0	8.8	35.0	308.0
Totals	40	100	177.0[1,2]	--	656.4

1 Acres of type from most recent Timber Management Plan (1975-76).

2 Acres for each category shown in column 4 = % shown in column 3 X 177.0 acres.

Table X. Acres of dwarf mistletoe infestation represented by survey plots and merchantable cubic-foot volume loss estimates for the Rio Grande National Forest lodgepole pine stands by seven dwarf mistletoe severity categories.

Dwarf mistletoe severity category	No. plots	% Representation	M acres	Merchantable volume loss (cu ft/A/yr)	Total merchantable vol. loss/yr (M cu ft)
0	2	100	6.3	0.0	0.0
0.1 - 1.0	0	0.0	0.0	0.0	0.0
1.1 - 2.0	0	0.0	0.0	0.0	0.0
2.1 - 3.0	0	0.0	0.0	0.0	0.0
3.1 - 4.0	0	0.0	0.0	0.0	0.0
4.1 - 5.0	0	0.0	0.0	0.0	0.0
5.1 - 6.0	0	0.0	0.0	0.0	0.0
Totals	2	100	6.3[1,2]	--	--

1 Acres of type from most recent Timber Management Plan (1975-76).

2 Acres for each category shown in column 4 = % shown in column 3 X 6.3 acres.

Table XI. Acres of dwarf mistletoe infestation represented by survey plots and merchantable cubic-foot volume loss estimates for the Routt National Forest lodgepole pine stands by seven dwarf mistletoe severity categories.

Dwarf mistletoe severity category	No. plots	% Representation	M acres	Merchantable volume loss (cu ft/A/yr)	Total merchantable vol. loss/yr (M cu ft)
0	28	60.9	105.4	0.0	0.0
0.1 - 1.0	6	13.0	22.5	0.0	0.0
1.1 - 2.0	2	4.3	7.4	0.0	0.0
2.1 - 3.0	1	2.2	3.8	3.0	11.4
3.1 - 4.0	4	8.7	15.1	15.7	237.1
4.1 - 5.0	4	8.7	15.1	34.7	523.9
5.1 - 6.0	1	2.2	3.8	75.0	285.0
Totals	46	100	173.1[1,2]	--	1057.4

1 Acres of type from most recent Timber Management Plan (1975-76).

2 Acres for each category shown in column 4 = % shown in column 3 X 173.1 acres.

Table XII. Acres of dwarf mistletoe infestation represented by survey plots and merchantable annual cubic-foot volume loss estimates for the White River National Forest lodgepole pine stands by seven dwarf mistletoe severity categories.

Dwarf mistletoe severity category	No. plots	% Representation	M acres	Merchantable volume loss (cu ft/A/yr)	Total merchantable vol. loss/yr (M cu ft)
0	24	85.8	126.2	0.0	0.0
0.1 - 1.0	2	7.1	10.4	0.0	0.0
1.1 - 2.0	0	0.0	0.0	0.0	0.0
2.1 - 3.0	2	7.1	10.4	3.0	31.2
3.1 - 4.0	0	0.0	0.0	0.0	0.0
4.1 - 5.0	0	0.0	0.0	0.0	0.0
5.1 - 6.0	0	0.0	0.0	0.0	0.0
Totals	28	100	147.0[1,2]	--	31.2

1 Acres of type from most recent Timber Management Plan (1975-76).

2 Acres for each category shown in column 4 = % shown in column 3 x 147.0 acres.